970,753

PATENT SPECIFICATION

DRAWINGS ATTACHED

970,753

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International Classification:—B 29 c (B 65 b)

COMPLETE SPECIFICATION

Method and Device for Producing Transverse Weld Seams on Thermoplastic Tubes

We, HAMAC-HANSELLA AKTIENGESELLSCHAFT, a German Corporate Body, of Viersen, Germany, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method and device for producing transverse weld seams on tubes made of thermoplastic film, and particularly the application of this method to packaging machines in which the tubes are formed into filled bags. Such packaging machines produce simultaneously an upper transverse seam for a filled bag and a lower transverse seam for the subsequent bag, and sever the film tube between these two transverse seams.

In the known methods for producing transverse weld seams on tubes, the tube is compressed into a flat strip between a heated welding-bar and a counter-bar co-operating with this welding-bar the heating-bar fusing the thermoplastic material along a narrow strip corresponding to the width of the heating-bar. The fused parts of the tube wall pressed against one another between the heating and counter-bars coalesce so that the tube is closed by a transverse seam after the cooling down of this fused region. Since the tubes normally tend to assume the round tube shape, it is required in the known method to keep the tube compressed at the place where the transverse seam is to be made until the fused tube material has cooled down and solidified. Consequently in the so-called impulse welding method the welding-bar is heated only intermittently, i.e. the heating is interrupted to allow the fused thermoplastic material to cool. The weld has to cool down under the pressure of the welding- and counter-bars.

In the known methods, if cutting of the tubing is required, this is done either after welding the seam or simultaneously. In either case, owing to the pressure applied by the welding- and counter-bars to the plasticised material the thickness of a transverse seam produced according to these known methods is not greater and usually less than the sum of the thicknesses of the two inter-welded wall portions of the tube. Each single tube wall is accordingly usually thinner than the remaining wall of the bag at the point of transition from the bag wall proper to the transverse seam. Just this point of transition is however the most highly stressed place of the bag owing to the shear stresses occurring there is use. Bags, the transverse seams of which are produced according to the known method, consequently often tear at this point of transition, and are then useless.

A further disadvantage of the known method for producing the transverse seams on thermoplastic tubes lies in the fact that since the tube has to be kept pressed between the closed welding-bars until the material and the welding-bars have cooled down, the rate of working of packaging machines using this known method is accordingly limited.

Moreover the electrical plant of the known impulse welding device is complicated and liable to breakdowns, since the heating of the welding-bar has to be effected in dependence of the working cycle of the packaging machine.

The invention has the object of providing a method and device for producing the transverse weld seams on thermoplastic tubes which obviate these disadvantages. It has been found, that the thermoplastic tube often has a condition of internal stress in one direction resulting from the process of production. When a tube is warmed up so far that it begins to become plasticized it shrinks.

Upon shrinking, naturally the material thickens as compared with the original thickness. In fact, the shrinkage takes place pre-

[*Price 4s. 6d.*]

dominantly in the direction in which the tube had been drawn in the production process.

This new discovery is the basis of the present invention. The required transverse seams always run transversely of the longitudinal direction—i.e. of the direction of the shrinkage—of the tube. Thus if care is taken that the tube is free from any external longitudinal stress in the region where the transverse seam is to be made and the tube is left compressed between the welding-bars only until the film has been fused at the point of the transverse seam, the fused region may shrink until the transverse seam has cooled. Care has to be taken that the tube does not split open as soon as the welding-bars are moved away while the material is still liquid. The shrinkage of the tube at and immediately adjacent the transverse weld seam—the tube is plasticised adjacent the transverse weld seams by the heat of radiation of the welding-bars—leads to a thickening of the tube wall just in those regions where, as stated above, the highest stresses occur in use. The thickness of the weld seam accordingly exceeds the sum of the thicknesses of the two superimposed tube walls, and likewise the thickness of the tube wall increases by shrinkage immediately adjacent the transverse weld seam. The shear stresses occurring at these points of transition between the transverse weld seams and the walls of the bags when the bags are filled are accordingly taken by a thicker wall cross sectional area, so that the stresses per unit cross-section are lower.

Accordingly, the invention provides a method for producing transverse weld seams on tubular films of thermoplastic material, wherein the tubing is first pressed flat at two positions spaced on opposite sides of the desired position of the transverse seam; that it is then freed in this region from any external tensile stress in the longitudinal direction of the tubing so that it is free to shrink in that direction when softened by heat; and thereafter the production of the seam is then effected by welding in such a manner that the welding tools, after the fusing of the material of the tube in the region of the transverse seam are moved away from the tube before the seam has cooled down and solidified.

In the case where the tubing is required to be cut into sections, e.g. to form bags, the method according to the invention comprises the steps of first clamping the tubular film into the flat condition by clamping pressure applied at two different regions spaced at opposite sides of the desired weld position, severing the material in the transverse direction between the said clamping regions to free it from any longitudinal stress, and finally welding transverse seams across the segments of tubing at each side of the parting line, the severing and welding operations being so arranged that, after severing the film, the segments of tubular film thus formed can shrink in the longitudinal direction under the influence of heat from the welding tool whilst being held at the clamping regions, and that the welding tool is removed from the seams before the seams have cooled down and solidified whilst the segments of tubular film are still clamped at the said regions.

According to a further feature of the invention, there is provided a device for carrying out the above method, comprising two channel-section clamping bars, arranged transversely of the tubing, which passes between them, and movable so that the extending flanges of the two bars co-operate to clamp the tubing between them at the two spaced regions, two channel-section welding bars arranged transversely of the tubing, one each side thereof within the channels of the clamping-bars and movable independently of the clamping bars into contact with the tubing after the clamping bars have engaged the tubing, so that the extending flanges of the two welding bars co-operate to weld the tubing along two transverse regions lying between said two spaced regions, and a severing device movable to cut the tubing transversely along a line lying between said two transverse regions, the severing device, in operation, being arranged to cut the tubing whilst clamped by the clamping bars but before the welding-bars weld the tubing.

In operation, the tube is pressed flat and held fast by the pairs of clamping-bars either side of the position of the two transverse weld seams. Then the cutting tools sever the flat strip between the positions of the required seams so that the same is freed from external longitudinal tensile stresses. Then the material is fused by the welding tool at the places where the transverse weld seams are to be produced. The welding tools are moved away from the tube before the same has cooled down and solified, so that the film can shrink as described, in the warm plasticised condition. The opening up of the seam while still in the warm plasticised condition is prevented by the clamping-bars, which still maintain the tube pressed flat at the clamping regions spaced at opposite sides of the position of the welded seams.

In the bags produced by this device the transverse weld seams do not occur exactly at the ends of the individual bags but more or less displaced from the edges of the bag, depending on the size of the webs of the welding bars. If it is desired to have the transverse weld seams nearer to the extreme upper and lower end of the bag, the production of the transverse weld seams and severing of the tube between the seams may be effected by means of cutting- and welding-bars. Preferably one of the bars is shaped to do this work and the opposite bar serves as a support plate or anvil.

Accordingly, there is further provided according to the invention, a device for carrying out the above method, comprising two channel-section clamping bars, arranged transversely of the tubing, which passes between them, and movable so that the extending flanges of the two bars co-operate to clamp the tubing between them at the two spaced regions, and two cutting-and welding-bars arranged transversely of the tubing, one each side thereof within the channels of the clamping-bars and movable independently of the clamping bars into contact with the tubing after the clamping bars have engaged the tubing, said cutting-and welding-bars cutting the tubing across the two severed ends.

In order that the invention may be more clearly understood, two embodiments of a device according to the invention for carrying out the method of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 shows diagrammatically a section of a first embodiment of a device, shown in the open position;

Figure 2 shows the device of Figure 1 in the position in which the clamping-bars have closed and the tube is about to be cut;

Figure 3 shows the device of Figure 1 during the welding of the material;

Figure 4 shows the device of Figure 1 after the welding-bars, but before the clamping-bars have parted;

Figures 5—8 show a second embodiment of a device according to the invention, at succeeding stages of the welding operation.

The reference numerals 1 and 2 denote two U-profile clamping-bars. The bars comprise webs 4 and extending flanges 3. At the forward edges of the flanges 3 resilient strips 5 are arranged. Between the clamping-bars 1 and 2 there runs a thermoplastic tube 11, with its longitudinal axis perpendicular to the longitudinal axes of the clamping-bars. The clamping-bars are movable from right to left as seen in the drawings. They are guided towards one another in such a manner that the resilient strips 5 meet one another, and press the tube 11 between them into a flat strip over a length which corresponds substantially to the height of the webs 4 of the clamping-bars.

Within the limits of the two clamping-bars 1 and 2, two U-profile welding-bars 6 and 7 are arranged also laterally movably, like the clamping-bars, their movements taking place independently of the movements of the clamping-bars. The welding-bars 6 and 7 consist of webs 9 and extending flanges 8. The webs 9 and the flanges 8 are shorter than those of the clamping-bars. At the edges of the flanges of the welding-bars the welding tools 10 are attached. The ends of the flanges 8 of the welding-bar 6 may carry electrically heated welding-bars proper, while the flanges 8 of the welding-bar 7 carry corresponding counter-bars. The counter-bars may obviously also be heated.

On the outside of the webs 9 of the welding rails 6 and 7 are fixed rods 13 which pass through the webs 4 of the clamping-bars. By means of these rods 13 the welding-bars 6 and 7 may be moved independently of the movements of the clamping-bars 1 and 2.

Within the welding-bars and parallel to the flanges 8, a knife edge 12 is fixedly attached in the middle of the web 9 of the welding-bar 7. This knife edge protrudes forwardly of the flanges 8 and upon movement of the welding-bars towards one another the knife edge 12 reaches the flat tube 11 before the welding tools 10, and severs it before the welding tools fuse the material in the region of the required transverse seam.

In Figures 1 to 4 the various stages of operation of the device are illustrated. The tube moves from the top to the bottom. Above the device illustrated in the Figures there is located the feeder device for the tube, which is pulled downward into the transverse sealing device. Below the device illustrated in the Figures there is a filled bag, which is still open at its top, and has not yet been severed from the tube. By means of the device illustrated an upper transverse seam for the filled bag below the illustration, and a lower transverse seam for the next following bag are produced simultaneously while the tube is cut between the two transverse seams, so that the filled and sealed lower bag drops off after the presser jaws 1 and 2 are opened.

The device operates as follows: In Figure 1 the tube is suspended between the opened clamping and welding jaws. Firstly, the clamping-bars are moved towards one another, as illustrated in Figure 2, so that the resilient strips 5 contact one another, whereby clamping the tube so that it forms a narrow strip of two superimposed sheet, as shown in Figure 2. The tube is subject to certain external longitudinal stresses generated by the downward movement of the tube or by the weight of the filled bag suspended at the lower end thereof. This tensile stress remains preserved also in that part of the tube which is clamped between the upper and lower flanges 3 of the clamping-bars. Next, the welding-bars are moved towards the flat strip. The knife edge 12 reaches the film strip first and severs the strip substantially midway between the upper and lower flanges 3 of the clamping-bars. Since the strip is fixedly clamped between the resilient strips 5, the filled lower bag is then supported by the lower flanges 3 of the clamping-bars. The severing of the tube between the clamping-bars has the consequence that the external longitudinal tensile stresses hitherto prevailing in the material between the clamping-bars are relieved.

Then, as shown in Figure 3, the welding-bars are moved against one another clamping between them the two free ends of the tube. The welding-bars are hot and quickly fuse the tube material, thereby also plasticising those parts of the tube which are located immediately adjacent the welding tools 10 proper. At this moment, i.e. when that part of the tube where the transverse seam proper is formed is still fused and the immediately adjacent part of the tube is plasticised, the welding-bars 6 and 7 are moved away from the material. The clamping-bars 1 and 2 remain closed. There are then no external longitudinal stresses in the ends of the tubes between the clamping jaws, so that the shrinkage described hereinabove can take place, which has the consequence that on the one hand the weld seam itself becomes thicker than the sum of two superimposed tube walls and that on the other hand the tube increases in thickness also immediately adjacent the transverse weld seams proper. This condition is illustrated in Figure 4. The clamping jaws 1 and 2 remain closed until the transverse weld seams have cooled down and solidified. Thereafter the clamping jaws are opened, the filled lower bag drops off; the tube is moved again downward between the two clamping jaws, and the process begins anew. It is of advantage, that the welding tools 10 need not be heated intermittently to match the operating sequence of the packaging machine, as in the impulse welding method, but may be heated continuously or if desired intermittently, independently of the sequence of the packaging machine. Advantageously the heating will be effected in dependence on a thermostat, which sets an upper limit to the temperature of the welding tools.

Instead of the knife edge 12 any other severing device may be provided, which severs the tube before forming the transverse weld seams (e.g. a fusion cutter).

When the individual bags are not to be severed from one another, the strip between the clamping-bars 1 and 2 may be freed from external longitudinal stresses by other means, for example by moving the flanges of each of the clamping-bars slightly towards one another after the closing of these bars.

The following description of Figures 5 to 8 is similar to that of Figures 1 to 4. Corresponding parts are denoted by the same reference numerals.

In Figures 5 to 8 the U-profile clamping-bars 1, 2 comprise webs 4 and flanges 3. At the forward edges of the webs 3 resilient strips 5 are arranged. The tube 11 runs between the clamping-bars 1, 2, so that the longitudinal axis of the tube runs perpendicular to the longitudinal axes of the clamping-bars. The bars are movable laterally as seen in the drawing. They may be moved towards one another so that the resilient strips 5 abut one another, and clamp the tube 11 between them into a flat strip over a length corresponding substantially to the height of the webs 4 of the bars.

Within the recesses of the U-profiles of the two bars 1 and 2 cutting- and welding-bars 26 and 27 are arranged. These bars 26 and 27 are, like the presser-bars, laterally movable as viewed in the drawings, their movements taking place independently of the movements of the clamping-bars. The size of the cutting- and welding-bars 26 and 27 is so chosen that they can be completely retracted into the recesses of the U-profile bars 1 and 2. On the edge of the bar 26 facing the tube 11 is fixed a sealing tool 28. This tool is a bar-shaped electrical heating resistor element, the profile of which is triangular in the embodiment illustrated. On the edge of the bar 27 facing the film strip 11, a counter-bar 29 is fixed. This counter-bar 29 serves as an anvil for the sealing tool 28 when severing the strip 11. The counter-bar 29 may also be heated. On the back of the bars 26 and 27, rods 30 are fixed which pass rearwardly through apertures in the webs 4 of the clamping-bars 1 and 2. The cutting- and welding-bars 26 and 27 are movable by means of these rods 30 by a mechanism which is not shown.

An operating cycle of the device is illustrated in Figures 5 to 8. In Figure 5 the clamping-bars and the sealing tools are opened, so that the tube 11 is suspended between these opened bars. The cutting- and welding-bars are completely retracted into the recesses of the clamping-bars. In operation firstly the clamping-bars 1 and 2 are closed to clamp the tube 11 into a flat strip between the resilient strips 5 over a length which corresponds substantially to the height of the webs 4 of the clamping-bars.

This condition is illustrated in Figure 6.

Then the cutting- and welding-bars 26 and 27 are moved towards one another. When these bars meet one another at the strip 11, the leading edge of the triangular sealing tool 28 severs the film tube 11. In the part of the tube 11 between the upper and lower flanges 3, the longitudinal stresses in the material are relieved at this moment by the severing of the tube. The two angled faces of the sealing tool 28 of Figure 7 preferably include an acute angle with the strip 11, so that after the leading edge of the tool 28 severs the strip, these faces fuse the ends of the tube 11 thus formed. After the severing of the material and the fusing of the ends, the sealing tools 26 and 27 are at once retracted into the interior of the clamping-bars 1 and 2. Figure 8 illustrates this condition. The fused ends of the strip are still liquid at this moment. The clamping-bars 1 and 2 remain closed until these fused edges have cooled down and solidified, and then form the transverse weld seams 32. Thereafter the clamping jaws 1 and 2

open, and after another movement of the tube, the working cycle begins anew.

The solidifying of the transverse weld seams 32 takes place free from any longitudinal tensile stress existing in the tube in the region of the transverse weld seams. The material can accordingly shrink during the solidifying period in the manner described hereinabove, so that eventually the thickness of the transverse weld seam 32 exceeds the sum of the thicknesses of the two mutually interwelded tube walls, or is at least equal to this sum. The tube is heated also immediately adjacent the transverse weld seams 32 by the heat of radiation of the tool 28, so that a certain shrinkage occurs also in these regions.

Instead of a triangular profile, the sealing tool 28 may have alternatively a rectangular profile in which case a rib is then provided at the front of the tool 28 at the place where in the embodiment illustrated the triangular cutting- and welding-edge is located. The rib effects severing of the tube.

The heating of the tool 28 may be effected continuously or intermittently, in any case, however, independently of the operating cycle of the packaging machine. Preferably the temperature of the sealing tool will be controlled by means of a thermostat, which interrupts the heating when a predetermined maximum temperature is reached.

The control of the movements of the clamping-bars and welding bars, or of the cutting- and welding-bars respectively, may be effected advantageously in any automatic manner, so that these bars are moved to-and-fro in the sequence described.

WHAT WE CLAIM IS:—

1. A method for producing transverse weld seams on tubular films of thermoplastic material wherein the tubing is first pressed flat at two positions spaced on opposite sides of the desired position of the transverse seam; that it is then freed in this region from any external tensile stress in the longitudinal direction of the tubing so that it is free to shrink in that direction when softened by heat; and thereafter the production of the seam is then effected by welding in such a manner that the welding tools, after the fusing of the material of the tube in the region of the transverse seam are moved away from the tube before the seam has cooled down and solidified.

2. A method for producing transverse welded seams on tubular films of thermoplastic materials comprising the steps of first clamping the tubular film into the flat condition by clamping pressure applied at two different regions spaced at opposite sides of the desired weld position, severing the material in the transverse direction between the said clamping regions to free it from any longitudinal stress, and finally welding transverse seams across the segments of tubing at each side of the parting line, the severing and welding operations being so arranged that, after severing the film, the segments of tubular film thus formed can shrink in the longitudinal direction under the influence of heat from the welding tool whilst being held at the clamping regions, and that the welding tool is removed from the seams before the seams have cooled down and solidified whilst the segments of tubular film are still clamped at the said regions.

3. A device for carrying out the method of claim 2, comprising two channel-section clamping-bars, arranged transversely of the tubing, which passes between them, and movable so that the extending flanges of the two bars cooperate to clamp the tubing between them at the two spaced regions, two channel-section welding bars arranged transversely of the tubing, one each side thereof within the channels of the clamping-bars and movable independently of the clamping-bars into contact with the tubing after the clamping-bars have engaged the tubing, so that the extending flanges of the two welding bars co-operate to weld the tubing along two transverse regions lying between said two spaced regions, and a severing device movable to cut the tubing transversely along a line lying between said two transverse regions, the severing device, in operation, being arranged to cut the tubing whilst clamped by the clamping-bars but before the welding-bars weld the tubing.

4. A device according to claim 3, wherein the severing device is a knife.

5. A device according to claim 3 wherein the severing device operates by fusing the thermoplastic material.

6. A device according to any of claims 3 to 5 wherein at least one of the welding-bars is heated.

7. A device according to claim 6 wherein the heating is electrical.

8. A device for carrying out the method of claim 2 comprising two channel-section clamping-bars, arranged transversely of the tubing, which passes between them, and movable so that the extending flanges of the two bars cooperate to clamp the tubing between them at the two spaced regions, and two cutting- and welding-bars arranged transversely of the tubing, one each side thereof within the channels of the clamping-bars and movable independently of the clamping-bars into contact with the tubing after the clamping-bars have engaged the tubing, said cutting- and welding-bars cutting the tubing transversely between said two spaced regions and then welding the tubing across the two severed ends.

9. A device according to Claim 8 wherein at least one of said cutting- and welding-bars is heated.

10. A device according to claim 9 wherein the heating is electrical.

11. A device according to either of claims 9 or 10 wherein one of said cutting- and

welding-bars is substantially triangular in cross section having two welding faces running into a leading cutting edge whereby when said bars are moved together, the tubing is first cut by the leading edge of the triangular section bar and the severed ends of the tubing are then welded across their width by the heat of radiation from the two adjacent faces of the bar.

12. A device according to either of claims 9 or 10 wherein one of said cutting- and welding bars is of substantially rectangular cross section with a longitudinally extending rib projecting from the face opposite the tubing, whereby when said bars are moved together the tubing is first cut by said rib and the severed ends of the tubing are then welded across their width by the heat of radiation from the face of the bar having the rib.

13. A device according to either claim 11 or claim 12, wherein the other cutting- and welding-bar has a flat face opposite the tubing against which the leading edge of the triangular bar or the longitudinally extending rib, respectively, may abut.

14. A device according to any of claims 3 to 13 wherein the extending flanges of said two channel-section bars have resilient strips on the edges facing the tubing.

15. A device substantially as herein described with reference to Figures 1 to 4 or Figures 5 to 8.

16. A method for producing transverse weld seams on thermoplastic tubing substantially as herein described.

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For the Applicants.

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Fig.1

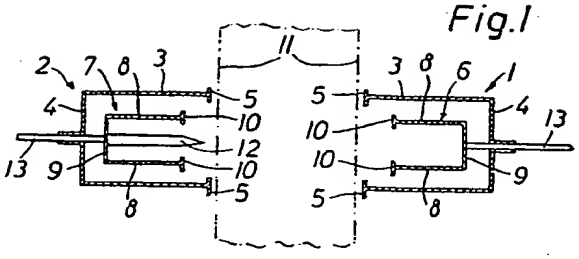


Fig.2

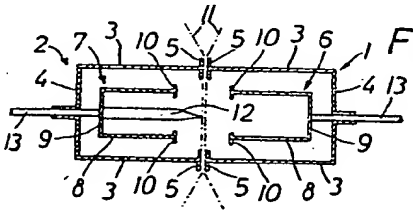


Fig.3

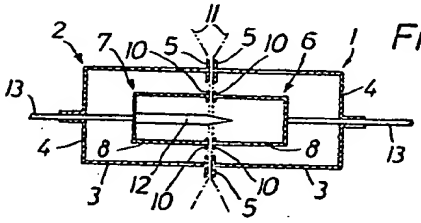
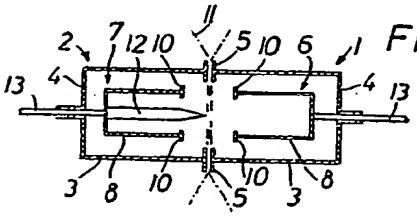


Fig.4



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Sheets 1 & 2

Fig.1

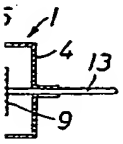


Fig.2

Fig.3

Fig.4

Fig.5

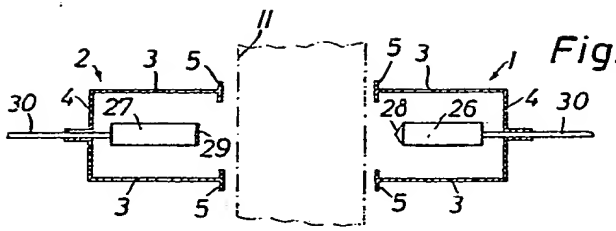


Fig.6

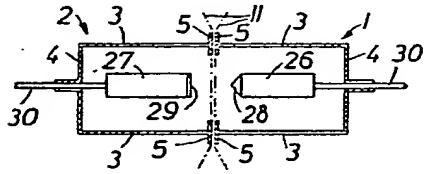


Fig.7

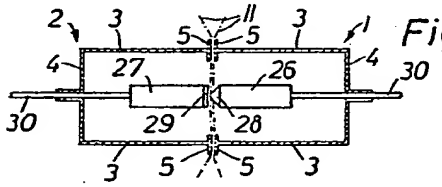
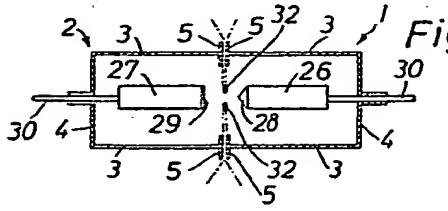


Fig.8



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Sheets 1 & 2

Fig.1

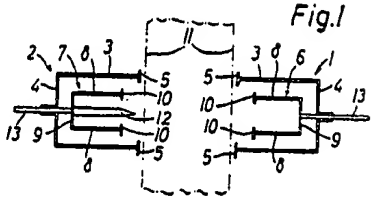

Fig.2

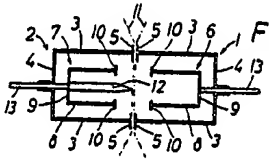

Fig.3

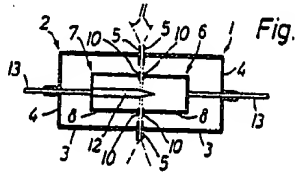

Fig.4

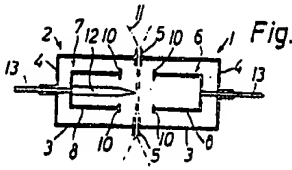

Fig.5

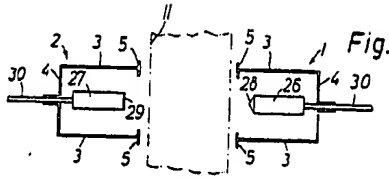

Fig.6

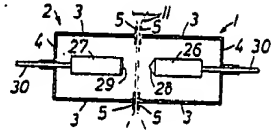

Fig.7

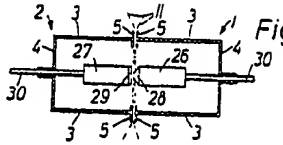

Fig.8